IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 10, Issue 3 (Sep.- Oct. 2013), PP 17-22
www.iosrjournals.org

Metabolic Syndrome Prevalence in Healthy Individuals in University Of Port Harcourt Teaching Hospital (Upth), Port Harcourt

Odum E.P*, Orluwene C.G*.
MBBS, FMCPathB.Med. Sci; MBBS; FMCPath
** Department Of Chemical Pathology, University Of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State, Nigeria.*

Abstract: *The metabolic syndrome is a cluster of metabolic risk factors characterized by insulin resistance. It promotes the development of atherosclerotic cardiovascular disease and/or type 2 diabetes. There has been a consistent increase in its prevalence globally, which has paralleled that of obesity and type 2 diabetes.*

The aim of this study is to determine the prevalence of metabolic syndrome in apparently healthy individuals in the University of Port Harcourt Teaching Hospital using the revised National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III; 2005) and World Health Organization (WHO; 1999) definitions.

Metabolic syndrome risk factors and prevalence were evaluated in 267 non-diabetic, apparently healthy individuals selected from the hospital environment.

According to the ATP III and WHO definitions respectively, the overall prevalence of metabolic syndrome was 15.7% and 10.9%. The prevalence increased markedly with age and peaked in the age range of 50-59 years with both definitions. With the ATP III and WHO definitions, sex-specific prevalence rates were 21.5% and 12.5% for females and, 8.9% and 8.9% for males respectively.

High blood pressure was the most frequent component of metabolic syndrome with the ATP III definition while obesity was the most frequent component with the WHO definition.

The ATP III definition gave a higher prevalence than the WHO definition and thus identifies a greater number of individuals at high risk of CVD and T2D. By managing these individuals at this early stage the public health burden of these diseases can be reduced.

Keywords: *Metabolic-syndrome, Prevalence, Adult-Treatment-Panel III, World-Health-Organization, Healthy-individuals, Port Harcourt.*

I. Introduction

The metabolic syndrome (MS) is a heterogeneous group of cardiovascular risk factors that are metabolically inter-related. Several studies have demonstrated rapidly rising prevalence rates globally [1]. Prevalence rates in Nigeria have been estimated to be between 16-35% in the general population [2-4] and 25-86% among subjects with type-2 diabetes (T2D) [5-8]. Most of the studies done on the prevalence of metabolic syndrome in Nigeria have been on T2D patients. Presently, studies on metabolic syndrome prevalence in the healthy population are scanty.

Definitions of metabolic syndrome differ among different research organizations and several diagnostic criteria have been established with the primary aim of identifying individuals with metabolic syndrome, which is a better predictor of future cardiovascular disease (CVD) and T2D than its individual risk factors taken separately. The risk of coronary heart disease in individuals with metabolic syndrome is 2 to 5-folds higher than in those without metabolic syndrome [1].

Some groups like the American Association of Clinical Endocrinologists (AACE) and the European Group for the Study of Insulin Resistance (EGIR) excluded T2D from their definition of metabolic syndrome because they considered insulin resistance to be the core component of the metabolic syndrome and a predictor of T2D. Furthermore, T2D alone adequately defines high cardiovascular risk [1,9,10]. However, other groups like the World Health Organization (WHO), National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) and the International Diabetes Federation (IDF) included T2D in their definition of metabolic syndrome because of the greater degree of insulin resistance and the higher risk for CVD among T2D patients with concomitant metabolic risk factors [1,10,11]. The first line of management of the metabolic syndrome is to reduce insulin resistance by modifying the underlying risk factors through lifestyle changes. In the presence of diabetes, risk factor management needs to be intensified and drug therapy for risk factors may be required [10,11].

The ATP III definition provides a framework for evaluating the main features of the metabolic syndrome; it is widely used and readily measured in clinical practice [10, 12]. It was updated in 2005, reducing the threshold for impaired fasting glucose (IFG) from 6.1 mmol/L (110mg/dL) to 5.6 mmol/L (100 mg/dL) to correspond to the current American Diabetes Association (ADA) criteria for IFG [1,10]. The ATP III definition does not emphasize on any single factor for diagnosis but included abdominal obesity rather than overall obesity because waist circumference has been demonstrated to have stronger correlations with insulin resistance, visceral adipose tissue and metabolic risk factors than body mass index (BMI) [1,2,10]. The ATP III definition does not require insulin resistance or glucose intolerance for diagnosis and thus is more specific towards identifying individuals at high risk of developing CVD rather than T2D [1].

The WHO definition is based on evidence of abnormalities in glucose and/or insulin homeostasis and thus primarily targets individuals at high risk of developing T2D, if not already present. Unlike the ATP III definition, it included overall obesity based on BMI or waist-to-hip ratio (WHR) in its criteria [1,10].

This study purposes to determine the prevalence of metabolic syndrome in the University of Port Harcourt Teaching Hospital (UPTH) using the ATP III (2005) and WHO definitions without the inclusion of type 2 diabetic patients. Both definitions agree that the core criteria of metabolic syndrome include dysglycaemia (hyperglycaemia and/or insulin resistance), obesity (abdominal/overall), dyslipidaemia and raised blood pressure. However, some criteria and cut-off values differ between these definitions, implying that different definitions may identify different high-risk populations.

II. Subjects and methods

The study population was made up of a total of 267 participants, which included apparently healthy volunteers consecutively enrolled from hospital staff, medical students and relatives of patients attending the metabolic, general and medical out-patient clinics of UPTH. Approval was obtained from the hospital's research ethical committee.

Informed consent was given by participants and necessary clinical information was obtained from them with the use of questionnaires and also from the case folders of diabetic patients. Participants that were below 18 years, pregnant, acutely or chronically ill, had a history of diabetes mellitus, cardiovascular disease, heavy smokers and alcoholics were excluded. After a brief general examination, the blood pressure (BP) of each participant was measured using a standard mercury sphygmomanometer, waist circumference (WC) was measured just above the iliac crest and BMI was estimated from the height and weight.

Venous blood samples were collected after an overnight fast. Plasma glucose concentration was determined using the glucose oxidase method and plasma triglyceride (TG), total cholesterol (TC) and HDL-cholesterol were estimated by enzymatic methods. All biochemical analysis were carried out using the fully automated Dimension Expand (Siemens) analyzer.

The diagnosis of the metabolic syndrome was made based on two definitions [1,9, 13].

1. **NCEP-ATP III (2005) definition**: Participants with any three or more of the following criteria were included in the study: fasting plasma glucose (FPG) ≥ 5.6 mmol/L, waist circumference (WC)>102cm (men) and >88cm (women), blood pressure (BP) ≥130/85 mmHg, triglyceride (TG) ≥1.7 mmol/L, high density lipoprotein (HDL) <1.0 mmol/L (men) and < 1.3 mmol/L (women).

2. **WHO (1999) definition:** Participants with fasting plasma glucose ≥ 6.1 mmol/L OR random plasma glucose ≥ 7.8 mmol/L plus two or more of these other criteria: BMI >30 kg/m^2, BP ≥140/90 mmHg, TG ≥1.7 mmol/L, HDL <0.9 mmol/L (men) and < 1.0 mmol/L (women) were included.

III. Statistical Methods

Statistical analysis was done using the Statistical Package for Social Sciences (SPSS) software version 17.0 (SPSS Inc., Chicago, Illinois, USA). Results were presented as mean ± standard deviation and percentages. Means of continuous variables were compared using the unpaired student-t test. P-values ≤ 0.05 were considered significant.

IV. Results

Two hundred and sixty-seven apparently healthy individuals had complete data and satisfied the criteria for inclusion into the study. The subjects were made up of 123 (46%) males and 144 (54%) females and their ages ranged from 20 years to 78 years with a mean age of 37.7 ± 13.1 years. There was no statistically significant difference between the mean ages of men and women (P=0.982).

The prevalence of metabolic syndrome was 15.7% and 10.9% according to the ATP III and WHO definitions respectively. The prevalence increased markedly with age and peaked in the age range of 50-59 years

with both definitions (Figure 1). With the ATP III and WHO definitions, the prevalence in men was 8.9% in both cases and in women, 21.5% and 12.5% respectively.

In the total population studied, hypertension was the most frequent risk factor observed with both definitions (Table 1). In those with metabolic syndrome, according to the ATP III definition, hypertension was the most frequent component followed by central obesity but with the WHO definition, obesity was the most common component followed by hypertension. Hypertriglyceridaemia was the least common with both definitions (Table 1).

Prevalence of obesity and hyperglycaemia was higher in female subjects, while male subjects had a higher frequency of hypertension, hypertriglyceridaemia and low HDL using the ATP III definition (Table 2). The WHO definition gave similar results except that hyperglycaemia was higher in men (Table 2). There was a statistically significant difference between the mean HDL concentrations (P=0.001) and mean BMI (P=0.003) of men and women.

V. Discussion

From this study, the prevalence of metabolic syndrome according to the ATP III definition (15.7%) was higher than that of the WHO definition (10.9%). The lower cut-off values for blood pressure, fasting plasma glucose and higher values for HDL in the ATP III criteria may have contributed to this. Nwegbu et al and Wahab et al also conducted hospital-based studies of metabolic syndrome prevalence in healthy populations in Nigeria based on the ATP III criteria and arrived at a prevalence of 16.8% and 22% respectively [2,3]. These are similar to the findings in this study. Our findings were lower than those of Siminialayi et al which was also a hospital-based study done in Rivers State but included patients with various ailments including diabetes [4]. Higher prevalence rates were obtained in the United States, Canada and European countries [1,12,14,15]. It has been reported that blacks have a lower metabolic syndrome prevalence than whites [16].

Our findings of a higher prevalence with the ATP III definition were consistent with those obtained in a population-based study in Africa by Kelliny et al where the ATP prevalence was found to be higher than the WHO prevalence in the total population after exclusion of diabetic patients [9]. However, in a population-based survey in Cameroon by Fezeu et al, the highest prevalence of the metabolic syndrome was with the WHO criteria and the lowest with the ATP III criteria [13]. This may be attributed to their inclusion of insulin resistance measurement in their list of WHO diagnostic criteria.

The prevalence of metabolic syndrome has been shown to increase with age [9,13-15]. In this study, the prevalence of metabolic syndrome increased markedly with age and was highest in the age range of 50-59 years with both definitions. These findings are similar to those of other researchers [9,15]. However in a population-based study by Ford et al in the United States, metabolic syndrome prevalence peaked in the age range of 60-69 years [15]. This may be explained by the fact that this study made use of population-based data and had a much larger sample size; thus this age-range was well represented numerically. Furthermore, life expectancy is higher in American populations compared to African populations [16].

The male to female ratio of subjects in this study (1:1.2) showed a slight female preponderance. The prevalence of metabolic syndrome was also higher in females. This corroborates reports from earlier studies [3,8,9,12].

In subjects with metabolic syndrome, high blood pressure and obesity were the most frequent components of metabolic syndrome observed with the ATP III and WHO definitions respectively. Hyperglycaemia was the third most frequent component followed by low HDL and then, hypertriglyceridaemia with both definitions. Other studies have reported similar findings [2,9,12-14]. Blacks have been observed to have the highest prevalence of hypertension compared to other races [15,16]. High blood pressure was also observed to be more prevalent in men compared to women in this study. It has been demonstrated that hypertension is more common in men than in women through middle age until menopause in women, and that men have higher mean systolic and diastolic blood pressures compared with women in all ethnic groups [15,17]. Evidence suggests that oestrogen protects against hypertension via activation of the vasodilator pathway mediated by nitric oxide and prostacyclin, and inhibition of the vasoconstrictor pathway mediated by the sympathetic nervous system and angiotensin [16].

Female subjects were found to have a higher prevalence of central and general obesity than their male counterparts. It has been shown by previous studies that the prevalence of obesity is higher in women than in men [3,9,15]. The prevalence of central obesity based on waist circumference was found to be ten times higher in Cameroonian women than men [13]. A higher waist circumference in women compared with men has also been reported in the United States [15]. Similar findings have also been reported in Nigeria [3,6]. These findings may be due to genetic and hormonal differences between men and women, pregnancies in women and cultural practices that tend to limit physical exertion by women, resulting in sedentary habits [6].

The prevalence of metabolic syndrome has been demonstrated to increase markedly with increasing BMI for both sexes [14] and it has been stated that obese males and females have a 32-fold and 17-fold risk,

respectively, to develop metabolic syndrome compared to underweight and normal weight individuals [14]. The rising incidence of obesity parallels the increasing incidence of metabolic syndrome and T2D with a resultant increase in CVD and premature death [10,18]. Central obesity has been recognized as the key risk factor for the development of metabolic syndrome [13,14]. It promotes insulin resistance which is considered the core component of the metabolic syndrome [1,10,14] and contributes to the inflammatory component of metabolic syndrome via the secretion of inflammatory cytokines by adipose tissue [10,14].

Higher prevalence of dyslipidaemia was observed in men compared to women in this study. Before menopause, women are known to have lower total cholesterol, lower LDL, lower triglyceride and higher HDL levels than men because of the protective effect of oestrogen[19, 20]. This reduces the risk of developing coronary artery disease in women. However after the age of 60 years, men and women appear to have equal CVD risk [19, 20].

Study Limitations

There may have been some bias in our findings because it is a hospital-based study. Relatives of patients were included in this study. Relatives of individuals with heritable conditions are well known to have a greater risk of developing such conditions. Sharma et al reported that 33% of first-degree relatives of diabetics were found to have metabolic syndrome while 20% of their spouses had metabolic syndrome, indicating the importance of genetic and environmental factors in the development of metabolic syndrome [21]. Furthermore, staff of the hospital included in this study are more likely to have an increased awareness of the risk factors of metabolic syndrome and therefore may have been involved in some form of lifestyle modification, compared to individuals in the general population.

Currently, there is paucity of data in this environment on metabolic syndrome prevalence in the general population. A population-based study would provide a more representative assessment.

VI. Conclusion

The ATP III definition gave a higher prevalence (15.7%) of the metabolic syndrome than the WHO definition (10.9%) and thus identifies a greater number of individuals at high risk of CVD and T2D. It is important to identify and manage these individuals at this early stage in order to reduce the public health burden of chronic diseases like coronary heart disease and type 2 diabetes mellitus.

Table 1: Prevalence of risk factors in total population and metabolic syndrome (MS) subjects

Risk factor	Total population (N = 267)		MS subjects	
	ATP III (%)	WHO (%)	ATP III (%)	WHO (%)
High BP	41.6	34.8	90.5	72.4
Obesity	35.1	29.1	87.5	75.0
Hyperglycaemia	15.4	10.1	57.1	69.0
Low HDL	25.8	12.0	45.2	24.1
High TG	6.0	6.0	23.8	17.2

BP = Blood pressure
HDL = High density lipoprotein cholesterol
TG = Triglyceride

Table 2:Prevalence of metabolic syndrome components in men and women

	ATP III (%)		WHO (%)	
	Male	**Female**	**Male**	**Female**
High BP	93	87.1	72.7	72.2
Obesity	83.3	90.1	63.6	88.9
Hyperglycaemia	50.5	62.3	72.5	66.7
Low HDL	50.4	38.7	36.4	16.7
High TG	34.5	12.9	18.2	16.5

BP = Blood pressure
HDL = High density lipoprotein cholesterol
TG = Triglyceride

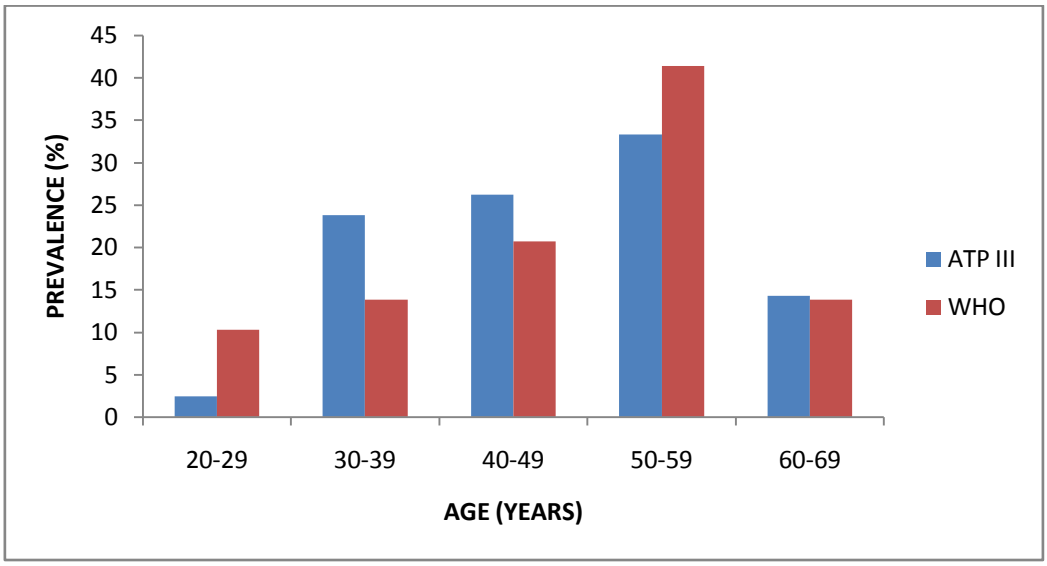

Figure 1: Age-specific prevalence of Metabolic Syndrome

References

[1] Desroches S, Lamarche B. The evolving definitions and increasing prevalence of the metabolic syndrome.*App PhysiolNutrMetab*2007; 32:23-32.
[2] Nwegbu MM, Jaiyesimi OO. Prevalence of metabolic syndrome amongst apparently healthy Nigerian adults in a hospital setting.*J Med MedSci* 2012;3:77-82.
[3] Wahab KW, Sani M, Gbadamosi M, Yandutse M. Frequency and determinants of the metabolic syndrome in apparently healthy adult Nigerians. *Tropical Doctor* 2008;38:224-226.
[4] Siminialayi IM, Emem-Chioma PC, Odia OJ. Prevalence of Metabolic syndrome in Urban and Suburban Rivers State, Nigeria: International Diabetes Federation and Adult Treatment Panel III Definitions. *Niger Postgrad Med J* 2010;17:147-153.
[5] Alebiosu CO, Odusan BO. Metabolic syndrome in Subjects with Type-2 Diabetes Mellitus.*JNatl Med Assoc* 2004, 96: 817-821.
[6] Isezuo SA, Ezunu E. Demographic and Clinical Correlates of Metabolic syndrome in Native African Type-2 Diabetic Patients. *J Natl Med Assoc* 2005; 97: 557-563.
[7] Unadike BC, Akpan NA, Peters EJ, Essien IO, Essien OE. Prevalence of the Metabolic syndrome among Patients with T2D Mellitus in Uyo, Nigeria. *African Journal Of Endocrinology and Metabolism* 2009;8:7-9.
[8] Ogbera AO. Prevalence and Gender Distribution of the Metabolic syndrome. *Diabetology& Metabolic syndrome* 2010;2:1-5.
[9] Kelliny C, William J, Risen W, Paccaud F, Bovet P. Metabolic syndrome according to different definitions in a rapidly developing country of the African region. *CardiovascularDiabetology* 2008;7:27-37.
[10] Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, Gordon DJ, et al. Diagnosis and Management of the Metabolic syndrome: a statement for health care professionals: An American Heart Association/National Heart, Lung and Blood Institute Scientific Statement. *Circulation* 2005; 112:2735-2752.
[11] Pi-Sunyer FX. Pathophysiology and Long-Term Management of the Metabolic syndrome. *Obes Res* 2004;12:174S-180S.
[12] Bonora E, Kiechl S, Willeit J, Oberhollenzer F, Egger G, Bonadonna RC et al. Metabolic syndrome: epidemiology and more extensive phenotypic description. Cross-sectional data from the Bruneck Study. *International Journal of Obesity* 2003;27:1283-1289.

[13] Fezeu L, Balkau B, Kengne A-P, Sobngwi E, Mbanya J-C. Metabolic syndrome in a Sub-Saharan African Setting: Central obesity may be the key determinant. *Atherosclerosis* 2007;193:70-76.
[14] Ervin RB. Prevalence of Metabolic syndrome Among Adults 20 years of age and over, by Sex, Age, Race and Ethnicity, and Body Mass Index: United States, 2003-2006. National health statistics reports; no. 13. Hyattsville, MD: National Center for Health Statistics. 2009.
[15] Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults. Findings from the Third National Health and Nutrition Examination Survey.*JAMA* 2002; 287: 356-359.
[16] Park Y-W, Zhu S, Palaniappan L, Heshka S, Carnethon MR, Heymsfield SB. The Metabolic syndrome: Prevalence and Associated Risk Factor Findings in the US Population from the Third National Health and Nutrition Examination Survey, 1988-1994. *Arch Intern Med* 2003;163:427-436.
[17] August P. Hypertension in men. *J ClinEndocrinolMetab*.1999; 84: 3451-3454.
[18] Roche HM, Phillips C, Gibney MJ. The Metabolic syndrome: the crossroads of diet and genetics. *Proceedings of the Nutrition Society* 2005;64:371-377.
[19] Sultan N, Nawaz M, Sultan A, Fayaz M, Baseer A. Effect of menopause on serum HDL-cholesterol level. *J Ayub Med Coll Abbottabad*.2003; 15: 24-26.
[20] Igweh JC, Nwagha IU, Okaro JM. The effects of menopause on the serum lipid profile of normal females of South Eastern Nigeria. *Nigerian Journal of Physiological Sciences*.2005; 20: 48-52.
[21] Sharma P, Mishra S, Ajmera P, Mathur S. Oxidative Stress in Metabolic Syndrome. *Indian Journal of Clinical Biochemistry* 2005; 20: 145-149.